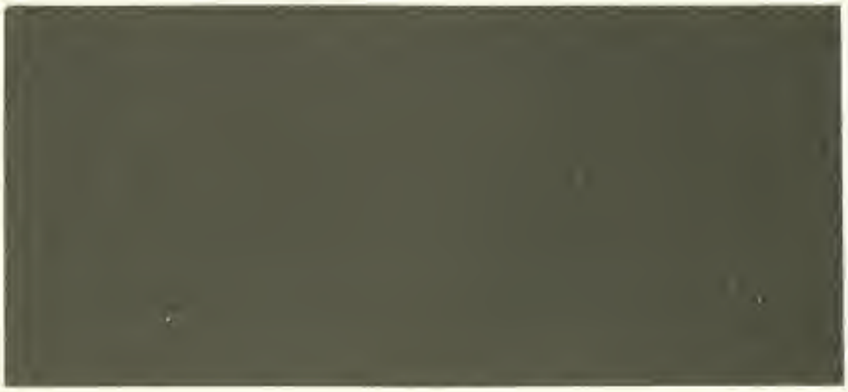
WORKING PAPER
ALFRED P. SLOAN SCHOOL OF MANAGEMENT

# Toward an Integration of Technology in Higher Education

Henry
Edgar H. Schein*
Organization Studies Group
Sloan School of Management

March 1972 #596-72

MASSACHUSETTS
INSTITUTE OF TECHNOLOGY
50 MEMORIAL DRIVE
CAMBRIDGE, MASSACHUSETTS 02139



Toward an Integration of Technology
in Higher Education

Edgar H. Schein*
Organization Studies Group
Sloan School of Management

March 1972

#596-72

*Professor of Organizational Psychology and Management, Chairman of the Organization Studies Group

## Introduction

The last two decades have seen the development of a great variety of educational innovations at the college and university level. Many of these innovations involve specific hardware such as films, videotape, teaching machines, programmed texts, and computers. When we speak of integrating educational technology, we often have in mind putting these specific hardware elements together into a coordinated kind of educational effort. I would like to define the problem somewhat more broadly. Based on my experience in helping to invent and implement several innovations at M.I.T. over the last five years, I have come to recognize that both the term technology and the term integration have broader meanings which must be considered if we are to understand the process of improving higher education.

---

Paper delivered at the meeting of The Institute of Management Science, Detroit, September 30, 1971. The research on which this paper is based was conducted under the sponsorship of the Carnegie Commission on Higher Education.

## Three kinds of integration

### 1. Horizontal integration of educational content and methods

This type of integration refers to the coordination of curriculum materials, teaching and/or learning methods, and various hardware components. Most of the focus of educational technology has been in this area. Thus, for example, in the 1950's the major efforts of the Education Research Center at M.I.T. focused on a new kind of teaching of science which would compensate for variations in teacher quality by reliance on outstanding written and audio-visual materials. Subsequently, E.R.C. attempted to supplement such materials with computer-aided instructional packages which would show difficult physical relationships or equations visually on computer displays. This work was very exciting and revolutionized a number of aspects of the teaching of science but the effort to compensate for the teacher with virtually foolproof materials ignored the fact that teachers might be threatened by such materials and might fail to use them in spite of their superior quality.

We have seen examples of very sophisticated "learning systems" developed by some of the new learning corporations which sound perfect on paper, except that they ignore the human element - the lack of <u>ability</u> of teachers and administrators to use the system and the lack of <u>motivation</u> to do so, because the adoption of the system requires a changed self-image on the part of the teacher. Horizontal integration produces elegant solutions, but not many of these solutions are in operation.

## Three Kinds of Integration

### 1. Horizontal integration of educational content and methods

This type of integration refers to the coordination of [illegible] materials, teaching and/or learning methods, and various learning components. Most of the [illegible] of educational [illegible] this area. Thus, for example, in the 1950's the [illegible] efforts of the educational research [illegible] of science [illegible] quality in [illegible] quantity, [illegible] [illegible]

[illegible]

2. Longitudinal integration

The difficulty of achieving horizontal integration in practice points us to the need for a second kind of integration of educational technology, having to do with the technology of change. The introduction of new methods, whether we are talking about a production line in industry or a learning system, involves a process of change which must be understood and managed. It is a process which occurs over time and involves various phases. In the case of educational technology, we can identify three such phases:

1) invention of new technological elements;
2) successful introduction of those elements into the educational system;
3) evaluation of the new elements as a basis for long range decisions.

In other words, once a new idea has been invented, it must still be implemented and then evaluated before we have a basis for deciding whether it is a better way to educate or not. When we talk of integrating these three elements, what I mean is that the process of implementation and evaluation should be thought of at the same time as one is inventing elements. Often we invent something and then wait for someone else to implement it. All too often we decide that something is a good idea and ramrod it through before even considering how we will determine whether or not it is achieving the goals we seek. Somehow we assume that the technology of evaluation is well worked out and that once we have produced changes, someone else can come in and

2. Longitudinal integration

The difficulty of achieving horizontal integration in a social [illegible]

evaluate them for us. Rarely do we make a conscious explicit effort to decide ahead of time exactly how we will evaluate an innovation so that we have a basis for judging whether or not it should survive.

This failure to integrate longitudinally has been painfully evident in our efforts to improve undergraduate education at M.I.T. We have launched a number of very exciting innovations - a complete pass-fail manner of grading for the freshmen to remove some of the great pressure we observed during the freshman year; an undergraduate research opportunities program which permits even freshman to get involved in live research as junior members of the research team; a loosening of the degree structure which permits students to put together a program across several disciplines; a number of self-paced courses which permit students to work with packages of curriculum material at their own pace, with tutorial help as they need it, and with examinations primarily for feedback rather than grades; a concentrated study option which is exploring whether or not it is more effective to learn one subject at a time, working on it for two to four weeks full time, rather than three times a week; and various project-centered laboratories and courses which attempt to involve the student in live problems early in his academic career.

All of these programs are highly touted, both by their inventors and by the students who have gone through them, yet when you encounter a skeptical professor who wants to know what good they are doing, are they better than the regular program, do they cost more or less, etc., we cannot answer his questions with any degree of precision. If you go back to the inventors and implementers they will generally not have

a clear plan of evaluation which satisfies anyone other than the members of the innovative program. Incidentally, I am strongly sympathetic to their position. When I have tried to innovate in courses of my own, I also wanted simply to draw my own conclusions and not be bothered by other people's need for hard evidence. But as I think about the problem, unless we can integrate longitudinally by building our evaluation schemes into the innovative projects from the outset, we will be perpetually vulnerable to the critic who will point out that the new innovation does no better but is clearly more expensive, or, if it does better, will say it is just the Hawthorne effect.

So far I have talked about the integration of evaluation into our educational innovations. Equally difficult is the problem of integrating the stage of implementation. We have many educational inventions lying around which are not being used because no one has thought about how to introduce them into a school system. Here we are dealing squarely with the technology of planned change about which we are beginning to know something, but remarkably little of the knowledge seems to me to be used by innovators. In particular, the innovator seems too often to be blind to the human factor - he sees the exciting possibilities of computer aided instruction, of cassettes, of movies, of simulation games, of programmed texts, of reprint series, etc. - and forgets all about the feelings of a teacher whose whole life is tied up in a cetain way of doing things, which he is suddenly asked to change dramatically. At the simplest level, we must face the fact that much of what is labelled as educational technology is directly challenging what the teacher has spent most of his life learning how to do - to personally organize and present

curriculum materials to learners who are assumed to be able to get the ideas if the teacher is clever enough and forceful enough in his presentation of them. The notion of the learner taking the initiative and using the teacher as a resource, an assumption upon which much of the recent technology rests, is a very recent idea for which most teachers are not trained. They do not know how to be consultants, how to organize learning resource centers, how to share authority with their students, how to trust students to manage their own learning. Deep down, many of them don't believe for a minute that students can be trusted to use learning aids, and that students are inwardly motivated. They can probably cite a great deal of evidence in support of their more pessimistic view of learner motivation.

As one example of the kind of care that must be taken in implementation, I can cite the recent history of the two most exciting innovations at M.I.T. Both of these are essentially learning communities, built on the assumption that if teachers, learners, and good resources are put together physically, they can work out a sensible program which truly meets the learner's needs. One of these communities, called the Unified Science Studies Program is project-centered and involves the student in a series of pre-designed projects or in projects which the student designs himself. The other, called the Experimental Study Group, is an even less structured community in which junior and senior learners (the faculty) come together to decide how best to organize the things to be learned and the methods by which to learn them. The latter program, in particular, focuses on the self-directed learner, the student who wishes to be freed of the restraints of requirements, schedules, grades, etc.

curriculum materials to diagnose the [illegible] and the

ideas if the textbook [illegible] enough and [illegible] enough. [illegible]

tation of them. The authors of the [illegible] stating the [illegible]

using the results [illegible]

recent technology [illegible]

are not typical [illegible]

learning research [illegible]

how to [illegible]

These [illegible]

learning [illegible]

produce [illegible]

views [illegible]

[illegible]

Both programs were opened two years ago to 50 freshmen each, and these were selected from an applicant pool of about 200. The 200 applicants represent about one fifth of the entering class. Last year another group of 50 were admitted, though the applicant pool shrank somewhat. This year, I am told that these two programs and another new interdisciplinary program have fewer applicants than ever. Of all the things we thought of in getting these programs off the ground, the one thing that none of us really believed possible was that there would be insufficient student demand for them.

Now why has this occurred? Several hypotheses suggest themselves: 1) students don't want low structure programs where they have to make their own decisions about what and how to learn; 2) the programs do not adequately prepare students for the junior and senior year at M.I.T., and this word is filtering back to freshmen; 3) the faculty who are not involved in the programs do not believe in them and are advising students not to get involved in them; 4) the programs are perceived to be too much out of the mainstream of the regular M.I.T. program and are therefore shunned by students.

We have no evidence yet where the truth lies, but one thing is obvious. If the programs die for lack of student support, they were a poor invention in the first place or there has been an implementation failure somewhere. Maybe inventing a good idea was not enough. It has to be implemented in such a way that it would become more integral to the system, and it had to generate evaluation data which would be convincing to others of the value of the innovation. So my second point is that we need more longitudinal integration around the invention-implementation-evaluation cycle.

## 3. Vertical integration

The third meaning of integration is the most difficult to explain because it involves thinking through what it is that students are supposed to learn as they move from broad general elementary levels to specific, complex levels of a field underlying their career choice. In other words, we think of education as involving a period of learning basic skills, like reading, writing, and arithmetic; then in high school, an exposure to different disciplines, which presumably makes possible some initial decisions about career choice; then a period of vocational training for some, while others go to college where they are again exposed to more general education and a climate in which values are supposed to develop; finally, the college student chooses a profession and learns that profession through a sequence of learning the basic science underlying the profession, then the applied science, and finally the technical skills needed to perform in that profession. He is also supposed to learn the attitudes and ethics which surround professional performance.

It appears to me that what will be increasingly needed in the education of professionals is an integration of the basic science, applied science, skill and value components. These components are typically taught by quite different methods. Basic science is taught by lecture and reading; applied science is typically taught by laboratories and projects; skill components are typically taught by practicums, internships, and apprenticeships which involve the student more actively; and value issues are typically supposed to be explored in humanities courses or learned by example from senior people. If we are to integrate vertically, then the methods involved in the different components must themselves

## [illegible] Vertical Integration

The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
because it [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
to learn as they [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
complex [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
reading, writing, and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
differentiating [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
while [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
the [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]

be integrated. We must find a way of combining the involving aspects of a practicum with the didactic aspects of a lecture with the exploratory aspects of a seminar, so that a student can continuously recycle through basic, applied, and skill elements at a greater and greater degree of depth. As examples of efforts at such integration we can cite the Undergraduate Research Opportunities Program at M.I.T., which attempts to give students active involvement at an elementary level very early in their college career. Some medical schools are assigning patients to first year medical students; many architecture departments are setting up neighborhood planning and design centers where students can get real project experience.

The basic reason why such vertical integration is increasingly desirable is that it leads to more effective learning. If the student can relate basic science to what he will have to know in performing his professional role, he will learn the basic science better and will see better how to apply it in his job.

In order to think about this type of integration, it is very important not to over-generalize any given learning model. In other words, what works well for straight information transmission may work very poorly for the learning of attitudes and values. The computer and the film may be fantastically efficient for one type of learning and may be a total loss for another type. The problem of vertical integration will be how to put the various learning goals, learning methods, and hardware elements together into a coherent system that preserves the requirements of the different areas and things to be learned.

## Summary and Conclusion

I have tried to differentiate three kinds of integration of educational technology: 1) horizontal integration involves the coordination of materials and methods, and learning aids within a given component of a curriculum across one semester or year; 2) longitudinal integration involves the coordination of the processes of inventing a new educational method or learning aid, the process of implementing that method or aid, and the process of evaluating that method or aid; 3) vertical integration involves the thinking through of an entire two to four year educational program and integrating the basic science, applied science, skill, and value elements of that program, such that the student can learn all of the elements in a series of cycles, rather than sequentially as is presently the typical case.

My own hunch is that we have put too much effort on horizontal integration and not enough effort on either longitudinal or vertical integration. We have put too much emphasis on inventing hardware and software, and not enough emphasis on thinking through how to implement and evaluate what we have invented, or the relevance of the invention to anything beyond a single course with its limited set of goals. I believe that education involves the learning of many different things by many different methods and that we will only really have success with our innovations when they take into account the complexity of the educational process.